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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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Randhir P. S. Thakur

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EXAMINER

MARKHAM, WESLEY D

ART UNIT

PAPER NUMBER

1762

DATE MAILED: 12/18/2002

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/590,464

Applicant(s)

THAKUR, RANDHIR P. S.

Examiner

Wesley D Markham

Art Unit

1762

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 07 October 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 20-22, 24, 25, 29, 30 and 50-74 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

- 5) ☐ Claim(s) _____ is/are allowed.

- 6) ☒ Claim(s) 20-22, 24, 25, 29, 30 and 50-74 is/are rejected.

- 7) ☐ Claim(s) _____ is/are objected to.

- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

Response to Amendment

1. Acknowledgement is made of applicant's amendment B, filed as paper #10 on 10/7/2002, in which Claim 23 was canceled, Claims 20, 50, and 51 were amended, and Claims 52 – 74 were added. Claims 20 – 22, 24, 25, 29, 30, and 50 – 74 are currently pending in U.S. Application Serial No. 09/590,464, and an Office Action on the merits follows.

Drawings

2. This application has been filed with informal drawings which are acceptable for examination purposes only. Formal drawings will be required when the application is allowed.

Claim Objections

3. Claim 70 is objected to because of the following informality: The phrase, "...walls being made from an insulating materials" appears to contain a typographical error. The applicant is suggested to amend the phrase to read, "...walls being made from an insulating material". Appropriate correction is required.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claims 61 and 62 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.
6. Specifically, the limitation that the solid layer comprises a "dielectric material" (Claim 61) or a "conductive material" (Claim 62) is vague and indefinite because it is unclear what specific materials the applicant intends to include in the groups denoted by a "dielectric material" and a "conductive material".
7. Please note that, in light of applicant's amendment B, the rejection of Claim 50 under 35 U.S.C. 102(b), set forth in paragraph 10 of the previous Office Action (i.e., the non-final Office Action, paper #9, mailed on 4/2/2002), and the rejections under 35 U.S.C. 103(a), set forth in paragraphs 12 – 20 of the previous Office Action, are withdrawn.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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9. Claims 20 – 22, 24, 25, 29, and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nishizawa et al. (USPN 5,443,033) in view of Dautartas et al. (USPN 6,124,158), and in further view of Moore et al. (USPN 5,710,407).
10. Regarding independent Claim 20 (from which Claims 21, 22, 24, 25, 29, and 30 depend), Nishizawa et al. teach a method of forming layers in electronic devices, the method comprising providing a reaction chamber (Figure 1, reference number “1”, and Col.4, lines 21 – 22), placing a semiconductor wafer in the reaction chamber (Figure 1, reference number “12”, and Col.4, lines 54 – 56), heating the semiconductor wafer with a thermal heating device placed adjacent to the wafer (Figure 1, reference number “10”, and Col.4, lines 36 – 39 and 60 – 61), pulsing a precursor fluid into the reaction chamber to form a solid layer on the semiconductor wafer (Col.4, lines 52 – 69 and Col.5, lines 1 – 19), thereafter exposing the solid layer to light energy in the reaction chamber, wherein the precursor fluid is substantially exhausted and removed from the reaction chamber and the solid layer is exposed to light energy in between each pulse of the precursor fluid (Col.4, lines 65 – 66, Col.5, lines 3 – 8, Col.6, lines 22 – 28). Specifically, Nishizawa et al. teach that the substrate with the growing epitaxial layer is irradiated with UV irradiation continuously during the process of growth (Col.6, lines 22 – 28). This time period (i.e., the period of growth) includes the time period in which the chamber is exhausted between the pulses of reactant gases (Col.4, lines 52 – 68, and Col.5, lines 1 – 7). Nishizawa et al. do not explicitly teach that, between each pulse of precursor fluid, the reaction chamber is purged by flowing an inert gas through the

reaction chamber in order to substantially remove any precursor fluid not converted into a solid. However, Nishizawa et al. do teach that between the pulses of precursor fluid, the chamber is evacuated (Col.4, lines 60 – 68). Dautartas et al. teach a similar atomic layer epitaxial process for depositing a layer in a semiconductor device (Abstract). Further, Dautartas et al. teach that it was known in the art at the time of the applicant's invention to purge a reaction chamber with an inert gas between pulses of precursor gases to remove residual reactive material from the chamber in order to prevent reactions from taking place except on the surface of the substrate (Col.3, lines 23 – 67, and Col.4, line 1). Therefore, it would have been obvious to one of ordinary skill in the art to purge the reaction chamber of Nishizawa et al. with an inert gas between the precursor gas pulses (i.e., instead of simply evacuating the chamber between pulses as taught by Nishizawa et al.) in order to substantially remove any remaining vaporous precursor material from the chamber with the reasonable expectation of (1) success, as Dautartas et al. teach that such a process is possible and known in the art, and (2) obtaining the benefits of the inert gas purging step, such as removing residual reactive material from the chamber in order to prevent reactions from taking place except on the surface of the substrate. Dautartas et al. teach that this purging technique eliminates gas phase reactions and gas phase powder formation, both of which detract from the quality of the film (Col.3, lines 66 – 67, and Col.4, line 1). In addition, Nishizawa et al. do not explicitly teach that the reaction chamber is a "cold wall" chamber. Specifically, Nishizawa et al. are silent as to whether the chamber is a "hot wall" chamber or a

"cold wall" chamber. However, the reaction chamber of Nishizawa et al. does not appear to be directly heated, as the substrate temperature is maintained by the heater "10" placed adjacent to the substrate (see Figure 1 and Col.4, lines 60 – 61). Moore et al. teach a similar deposition method and apparatus to that of Nishizawa et al. (i.e., a deposition method and apparatus in which both a heating element placed adjacent to the substrate and radiant light source are utilized during the deposition process) (Abstract, Col.1, lines 28 – 32, Col.4, lines 1 – 25, Col.5, lines 25 – 28, and Col.14, lines 12 – 19). Moore et al. also teach that, in such a deposition system, a cold wall reaction chamber is preferred because undesirable deposits do not build up on the chamber walls (Col.2, lines 20 – 25). Specifically, Moore et al. teach that the walls of the chamber are maintained at a cool temperature relative to the operating temperature of the reaction chamber in order to avoid deposition of a film on the walls of the chamber. Such a deposited film would detrimentally absorb heat energy, thereby affecting the heat distribution in the reaction chamber and resulting in unacceptable temperature gradients in the wafer substrate. In addition, a film on the walls may undesirably produce particulates during reactor operation, thereby contaminating the substrate (Col.19, lines 22 – 35). Therefore, it would have been obvious to one of ordinary skill in the art to use a cold wall chamber in the process of the combination of Nishizawa et al. and Dautartas et al. with the reasonable expectation of successfully and advantageously preventing unwanted film deposition on the reaction chamber walls, thereby

preventing unacceptable temperature gradients in the substrate and preventing particulate contamination of the substrate.

11. The combination of Nishizawa et al., Dautartas et al., and Moore et al. also teaches all the limitations of Claims 21, 22, 24, 25, 29, and 30 as set forth above in paragraph 10 and below, including a method wherein:

- Claim 21 – The precursor fluid comprises a gas (Col.4, line 61 of Nishizawa et al.).
- Claim 22 – The thermal heating device comprises an electrical resistance heater (Col.4, lines 33 – 39 of Nishizawa et al.).
- Claims 24 – 25 and 30 – The reaction chamber is maintained at a pressure of less than about 760 torr, preferably less than about 3 torr, preferably between about 10^{-2} torr and 10^{-7} torr, when pulsing the precursor fluid into the reaction chamber. Specifically, Nishizawa et al. teach a pressure of 0.1 Pascal, which correlates to about 7.5×10^{-4} torr (i.e., a pressure within the applicant's claimed range) (Col.4, lines 64 – 65).
- Claim 29 – The semiconductor wafer is maintained at a temperature of at least 100°C during formation of the solid layer. Specifically, Nishizawa et al. teach a substrate temperature of between 300 and 800°C (Col.4, lines 60 – 61).

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12. Claims 20, 21, 24, 25, 29, and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Utsumi et al. (USPN 5,495,822) in view of Dautartas et al. (USPN 6,124,158), and in further view of Moore et al. (USPN 5,710,407).
13. Regarding Claim 20, Utsumi et al. teach a process for forming layers in semiconductor devices comprising providing a reaction chamber, placing a semiconductor wafer in the reaction chamber, heating the semiconductor wafer with a thermal heating device placed adjacent to the wafer (Figure 3 and Col.5), pulsing a precursor fluid into the reaction chamber, the precursor fluid forming a solid layer on the semiconductor wafer (Figure 6 and Col.6, lines 1 – 30), thereafter exposing the solid layer to light energy in the reaction chamber wherein the solid layer is exposed to the light energy in between each pulse of the precursor fluid (Figure 6). Utsumi et al. do not explicitly teach that, between each pulse of precursor fluid, the reaction chamber is purged by flowing an inert gas through the reaction chamber in order to substantially remove any precursor fluid not converted into a solid. However, Utsumi et al. do teach that while the light energy is supplied, the flow of precursor gas is stopped (Col.5, lines 39 – 45). This is done to prevent the radiation from exciting the precursor gas to produce a vapor phase decomposed species that would deposit on the substrate (Col.5, lines 46 – 49). Dautartas et al. teach a similar atomic layer epitaxial process for depositing a layer in a semiconductor device (Abstract). Further, Dautartas et al. teach that it was known in the art at the time of the applicant's invention to purge a reaction chamber with an inert gas between pulses of precursor gases to remove residual reactive material from the chamber in

order to prevent reactions from taking place except on the surface of the substrate (Col.3, lines 23 – 67, and Col.4, line 1). Therefore, it would have been obvious to one of ordinary skill in the art to purge the reaction chamber of Utsumi et al. with an inert gas between the precursor gas pulses in order to substantially remove any remaining vaporous precursor material from the chamber with the reasonable expectation of (1) success, as Dautartas et al. teach that such a process is possible and known in the art, and (2) obtaining the benefits of the inert gas purging step, such as removing residual reactive material from the chamber in order to prevent reactions from taking place except on the surface of the substrate (i.e., preventing unwanted vapor phase decomposed species, as desired by Utsumi et al.). In addition, Utsumi et al. do not explicitly teach that the reaction chamber is a “cold wall” chamber. Specifically, Utsumi et al. are silent as to whether the chamber is a “hot wall” chamber or a “cold wall” chamber. However, the reaction chamber of Utsumi et al. does not appear to be directly heated, as the substrate temperature is maintained by the heater “4” placed adjacent to the substrate (see Figure 3 and Col.5, lines 19 – 20). Moore et al. teach a similar deposition method and apparatus to that of Utsumi et al. (i.e., a deposition method and apparatus in which both a heating element placed adjacent to the substrate and radiant light source are utilized during the deposition process) (Abstract, Col.1, lines 28 – 32, Col.4, lines 1 – 25, Col.5, lines 25 – 28, and Col.14, lines 12 – 19). Moore et al. also teach that, in such a deposition system, a cold wall reaction chamber is preferred because undesirable deposits do not build up on the chamber walls (Col.2, lines 20 – 25).

Specifically, Moore et al. teach that the walls of the chamber are maintained at a cool temperature relative to the operating temperature of the reaction chamber in order to avoid deposition of a film on the walls of the chamber. Such a deposited film would detrimentally absorb heat energy, thereby affecting the heat distribution in the reaction chamber and resulting in unacceptable temperature gradients in the wafer substrate. In addition, a film on the walls may undesirably produce particulates during reactor operation, thereby contaminating the substrate (Col.19, lines 22 – 35). Therefore, it would have been obvious to one of ordinary skill in the art to use a cold wall chamber in the process of the combination of Utsumi et al. and Dautartas et al. with the reasonable expectation of successfully and advantageously preventing unwanted film deposition on the reaction chamber walls, thereby preventing unacceptable temperature gradients in the substrate and preventing particulate contamination of the substrate.

14. The combination of Utsumi et al., Dautartas et al., and Moore et al. also teaches all the limitations of Claims 21, 24, 25, 29, and 30 as set forth above in paragraph 13 and below, including a method wherein:

- Claim 21 – The precursor fluid comprises a gas (Abstract of Utsumi et al.).
- Claim 24 – The reaction chamber is maintained at a pressure of less than about 760 torr (Col.6, line 19 of Utsumi et al.).
- Claim 25 - The reaction chamber is maintained at a pressure of less than about 3 torr (Col.6, line 19 of Utsumi et al.).

- Claim 29 – The semiconductor wafer is maintained at a temperature of at least 100° C during formation of the solid layer (Col.7, line 29 of Utsumi et al.).
- Claim 30 - The reaction chamber is maintained at a pressure of from about 10^{-2} torr to about 10^{-7} torr (Col.6, line 19 of Utsumi et al.).

15. Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Utsumi et al. (USPN 5,495,822) in view of Dautartas et al. (USPN 6,124,158), in further view of Moore et al. (USPN 5,710,407), and in further view of Murota et al. (USPN 5,705,224).

16. The combination of Utsumi et al., Dautartas et al., and Moore et al. teaches all the limitations of Claim 22 as set forth above in paragraph 13, except for a process wherein the thermal heating device comprises an electrical resistance heater. Utsumi et al. teach a thermal heating device in general placed adjacent to the substrate (Figure 3, reference number 4). Murota et al. teach a similar ALD process in which the substrate is successfully heated through the use of an electrical resistance heater placed adjacent to the substrate (Col.4, lines 24 – 37, and Figure 1, reference numbers 11 – 12). It would have been obvious to one of ordinary skill in the art to heat the substrate of Utsumi et al. with the electrical resistance heater of Murota et al. with the reasonable expectation of successfully heating the substrate as desired by Utsumi et al. through the use of an electrical resistance heater (i.e., selecting a well-known species (i.e., an electrical resistance heater) out of the broader genus of thermal heating devices taught by Utsumi et al.).

17. Claim 51 is rejected under 35 U.S.C. 103(a) as being unpatentable over DiMeo, Jr. et al. (USPN 5,972,430) in view of Murota et al. (USPN 5,705,224) and Nishizawa et al. (USPN 5,443,033).
18. Regarding Claim 51, DiMeo, Jr. et al. teach a process for forming layers in electronic devices (Col.1, line 14), the process comprising the steps of providing a reaction chamber, placing a semiconductor wafer substrate in the reaction chamber (Abstract and Col.11, lines 53 – 55), heating the substrate to a desired temperature during the deposition process (Col.10, lines 50 – 52), pulsing a precursor fluid into the reaction chamber, the precursor fluid forming a solid layer on the substrate, wherein the solid layer comprises a material selected from the group consisting of zirconium oxide, aluminum oxide, barium strontium titanate (BST), and a silicate (Abstract, Figs. 1 – 3, Col.7, lines 19 – 38, Col.9, lines 21 – 67, and Col.10, lines 1 – 40), and utilizing UV light energy as an additional activation means beyond thermal activation means in the process (Cols. 8 – 10, especially Col.10, lines 53 – 64), wherein the precursor fluid is substantially exhausted and removed from the reaction chamber in between each pulse of the precursor fluid (Figs. 2 – 3 and Cols. 9 – 10). DiMeo, Jr. et al. do not explicitly teach that the semiconductor wafer is heated with a thermal heating device placed adjacent to the wafer. However, DiMeo, Jr. et al. do teach that the substrate is heated to a temperature of from about 400 to 800° C during the deposition but are silent as to how the substrate is heated (Col.10, lines 50 – 52). Murota et al. teach a similar photo-induced ALD

process in which the substrate is successfully heated through the use of an electrical resistance heater placed adjacent to the substrate (Col.4, lines 24 – 37, and Figure 1, reference numbers 11 – 12). It would have been obvious to one of ordinary skill in the art to heat the substrate of DiMeo, Jr. et al. with the electrical resistance heater of Murota et al. with the reasonable expectation of successfully heating the substrate as desired by DiMeo, Jr. et al. and taught by Murota et al. through the use of an electrical resistance heater (i.e., selecting a well-known means of successfully heating a substrate out of the broader genus of heating a substrate in general as taught by DiMeo, Jr. et al. In addition, DiMeo Jr. et al. do not explicitly teach that the solid layer is exposed to light energy between each pulse of precursor fluid. Specifically, DiMeo, Jr. et al. are silent as to the specific timing of the UV light exposure, except to say that the UV light energy is used as an additional activation means beyond thermal activation means in the process. Nishizawa et al. teach a similar process (i.e., a process in which both thermal and UV light energy are utilized during a pulsed-precursor deposition) and teach that the UV-irradiation can be done either continuously or intermittently during the process of growth (Col.6, lines 22 – 28). By performing such a step, the deposition temperature can advantageously be reduced (Col.5, lines 3 – 6). Therefore, it would have been obvious to one of ordinary skill in the art to perform the UV light exposure of DiMeo, Jr. et al. continuously throughout the process (i.e., including between each pulse of precursor fluid) with the reasonable expectation of

successfully and advantageously activating the deposition process of DiMeo, Jr. et al. using UV light and reducing the deposition temperature.

19. Claim 50 is rejected under 35 U.S.C. 103(a) as being unpatentable over DiMeo, Jr. et al. (USPN 5,972,430) in view of Murota et al. (USPN 5,705,224) and Nishizawa et al. (USPN 5,443,033), and in further view of Gates et al. (USPN 6,203,613 B1).
20. The combination of DiMeo, Jr. et al., Murota et al., and Nishizawa et al. teaches all the limitations of Claim 50 as set forth above in paragraph 18, except for a method wherein the solid layer is a material selected from the group consisting of tungsten, tungsten nitride, tantalum nitride, titanium nitride, copper, aluminum, ruthenium oxide, iridium oxide, and silver. However, Gates et al. teach that such materials can be successfully deposited by using an ALD process (i.e., a process analogous to that of DiMeo, Jr. et al.) (Abstract, Col.4, lines 40 – 51, Col.5, lines 55 – 67, and Col.6, lines 1 – 57). It would have been obvious to one of ordinary skill in the art to utilize the deposition process of the combination of DiMeo, Jr. et al., Murota et al., and Nishizawa et al. to deposit the metal, metal oxide, and/or metal nitride layers taught by Gates et al. with the reasonable expectation of (1) success, as Gates et al. teach that such layers can be successfully deposited by an ALD process (i.e., a pulsed-precursor process, as taught by DiMeo, Jr. et al.) and (2) obtaining the benefits of using the process of the combination of DiMeo, Jr. et al., Murota et al., and Nishizawa et al., such as providing an additional activation means (i.e., UV light activation) for the process and reducing the deposition temperature.

21. Claims 52 – 55, 58 – 62, 66, 68 – 72, and 74 are rejected under 35 U.S.C. 103(a) as being unpatentable over DiMeo, Jr. et al. (USPN 5,972,430) in view of Moore et al. (USPN 5,710,407).
22. Regarding independent Claim 52, DiMeo, Jr. et al. teach a process for forming layers in electronic devices (Col.1, line 14), the process comprising the steps of providing a reaction chamber, placing a substrate in the reaction chamber, pulsing a precursor fluid into the reaction chamber (Abstract and Figs. 1 – 3), exposing the precursor fluid to light energy in the reaction chamber causing the precursor fluid to convert into a solid layer on the substrate (Cols. 8 – 10, especially Col.10, lines 53 – 64), wherein the precursor fluid is substantially exhausted and removed from the reaction chamber in between each pulse of the precursor fluid (Figs. 2 – 3 and Cols. 9 – 10). DiMeo, Jr. et al. do not explicitly teach that the reaction chamber is a “cold wall” chamber. Specifically, DiMeo, Jr. et al. are silent as to whether the chamber is a “hot wall” chamber or a “cold wall” chamber. Moore et al. teach a similar deposition method and apparatus to that of DiMeo, Jr. et al. (i.e., a deposition method and apparatus in which both heat and a radiant light source are utilized during the deposition process) (Abstract, Col.1, lines 28 – 32, Col.4, lines 1 – 25, Col.5, lines 25 – 28, and Col.14, lines 12 – 19). Moore et al. also teach that, in such a deposition system, a cold wall reaction chamber is preferred because undesirable deposits do not build up on the chamber walls (Col.2, lines 20 – 25). Specifically, Moore et al. teach that the walls of the chamber are maintained at a cool

temperature relative to the operating temperature of the reaction chamber in order to avoid deposition of a film on the walls of the chamber. Such a deposited film would detrimentally absorb heat energy, thereby affecting the heat distribution in the reaction chamber and resulting in unacceptable temperature gradients in the wafer substrate. In addition, a film on the walls may undesirably produce particulates during reactor operation, thereby contaminating the substrate (Col.19, lines 22 – 35). Therefore, it would have been obvious to one of ordinary skill in the art to use a cold wall chamber in the process of DiMeo, Jr. et al. with the reasonable expectation of successfully and advantageously preventing unwanted film deposition on the reaction chamber walls, thereby preventing unacceptable temperature gradients in the substrate and preventing particulate contamination of the substrate.

23. The combination of DiMeo, Jr. et al. and Moore et al. also teaches all the limitations of Claims 53 – 55, 58 – 62, 66, 68 – 72, and 74 as set forth above in paragraph 22 and below, including a method wherein:

- Claim 53 – The precursor fluid comprises a liquid vapor (Col.8, lines 22 – 47).
- Claim 54 – The precursor fluid comprises a gas (Col.8, lines 22 – 47).
- Claim 55 – The substrate comprises a semiconductor wafer (Col.11, lines 53 – 55).
- Claim 58 – The reaction chamber is maintained at a pressure less than atmospheric pressure when pulsing the precursor fluid into the reaction chamber (Col.10, lines 45 – 47).

- Claim 59 – The light energy is pulsed in substantial synchronization with the precursor fluid. While this limitation is not explicitly taught by DiMeo, Jr. et al., DiMeo, Jr. et al. do teach that the light activation is used in the deposition of the precursor layer and the oxidation of the precursor layer steps (i.e., when precursor gases are flowing) (Col.10, lines 53 – 64). DiMeo, Jr. et al. do not make any mention of utilizing the light energy during, for example, the inert gas purging steps. Therefore, it would have been obvious to one of ordinary skill in the art to pulse the light energy of DiMeo, Jr. et al. in synchronization with the precursor fluid pulses with the reasonable expectation of successfully aiding the deposition of the precursor layers as desired and taught by DiMeo, Jr. et al.
- Claim 60 – An inert gas is flowed through the reaction chamber in between pulses of the precursor fluid in order to purge the remaining precursor fluid from the reaction chamber (Figs. 2 – 3 and Cols. 9 – 10).
- Claims 61 and 62 – The solid layer comprises a dielectric material or a conductive material. Specifically, DiMeo, Jr. et al. teach that the solid layer can be BST, PZT, or SBT, which are dielectric materials (see, for example, Col.5, lines 53 – 60 of Kirilin et al. (USPN 6,320,213 B1)), or YBCO, which is a conductive material (see, for example, Col.4, lines 58 – 60 of Elmadjian et al. (USPN 6,420,251 B1)).

- Claim 66 – The solid layer comprises a material selected from the group consisting of zirconium oxide, aluminum oxide, a nitride, barium strontium titanate (BST), and a silicate (Col.7, line 26).
- Claim 68 – The chamber pressure is less than about 5 Torr when pulsing the precursor fluid into the reaction chamber (Col.10, lines 45 – 47).
- Claim 69 – The substrate is maintained at a temperature of at least 100° C during formation of the solid layer (Col.10, lines 48 – 52).
- Claims 70 and 72 – The reaction chamber includes walls, the walls being made from an insulating material, specifically quartz (Col.11, lines 58 – 67 of Moore et al.).
- Claim 71 – The reaction chamber includes a cooling system for cooling the walls of the chamber (Col.5, lines 20 – 25 of Moore et al.).
- Claim 74 – Between each pulse of precursor fluid, the solid layer being formed is cooled. While this limitation is not explicitly taught by DiMeo, Jr. et al., DiMeo Jr. et al. do suggest that the UV light energy is only utilized during the precursor pulsing steps and that an inert gas is flowed through the reaction chamber in between pulses of the precursor fluid (see discussion of Claims 59 and 60 above). As such, it is the examiner's position that the lack of UV light energy and the flow of inert gas between precursor fluid pulses would have inherently provided at least some cooling of the deposited layer (i.e., due to the lack of UV-light as an additional energy source and convection cooling of the deposited layer by the inert gas purge).

24. Claims 56 and 57 are rejected under 35 U.S.C. 103(a) as being unpatentable over DiMeo, Jr. et al. (USPN 5,972,430) in view of Moore et al. (USPN 5,710,407), and in further view of Murota et al. (USPN 5,705,224).
25. The combination of DiMeo, Jr. et al. and Moore et al. teaches all the limitation of Claims 56 and 57 as set forth above in paragraph 22, except for a process further comprising the step of heating the substrate with an electrical resistance heater during formation of the layer (Claim 56) and wherein the light energy is supplied by light energy sources positioned outside the reaction chamber (Claim 57). DiMeo, Jr. et al. do teach that the substrate is heated to a temperature of from about 400 to 800° C during the deposition but are silent as to how the substrate is heated (Col.10, lines 50 – 52). Murota et al. teach a similar photo-induced ALD process in which the substrate is successfully heated through the use of an electrical resistance heater placed adjacent to the substrate (Col.4, lines 24 – 37, and Figure 1, reference numbers 11 – 12). It would have been obvious to one of ordinary skill in the art to heat the substrate of DiMeo, Jr. et al. with the electrical resistance heater of Murota et al. with the reasonable expectation of successfully heating the substrate as desired by DiMeo, Jr. et al. and taught by Murota et al. through the use of an electrical resistance heater (i.e., choosing a well-known species (an electrical resistance heater) out of the broader genus of heating the substrate in general, taught by DiMeo, Jr. et al.). In addition, DiMeo, Jr. et al. are silent as to the placement of the light sources. Murota et al. teach a similar photo-induced ALD

process wherein the light sources are positioned outside the reaction chamber (Figure 1 and Col.5, lines 1 – 5). It would have been obvious to one of ordinary skill in the art to position the light sources of DiMeo, Jr. et al. outside the reaction chamber as taught by Murota et al. with the reasonable expectation of successfully treating the layer with light energy as desired by DiMeo, Jr. et al. without contaminating the light sources by placing the light sources outside the deposition chamber as taught by Murota et al.

26. Claim 73 is rejected under 35 U.S.C. 103(a) as being unpatentable over DiMeo, Jr. et al. (USPN 5,972,430) in view of Moore et al. (USPN 5,710,407), and in further view of Nishizawa et al. (USPN 5,443,033) and Thakur (USPN 5,863,327).
27. The combination of DiMeo, Jr. et al. and Moore et al. teaches all the limitations of Claim 73 as set forth above in paragraph 22, except for a process wherein, between selected pulses of the precursor fluid, the solid layer being formed is annealed. Specifically, DiMeo, Jr. et al. are silent as to any annealing process and are silent as to the specific timing of the UV light exposure, except to say that the UV light energy is used as an additional activation means beyond thermal activation means in the process. Nishizawa et al. teach a similar process (i.e., a process in which both thermal and UV light energy are utilized during a pulsed-precursor deposition) and teach that the UV-irradiation can be done either continuously or intermittently during the process of growth (Col.6, lines 22 – 28). In addition, DiMeo, Jr. et al. teach that their process is used to deposit a number of multi-component oxide films

(Col.7, lines 8 – 38). Thakur teaches that it is desirable to anneal a film such as the ones deposited by DiMeo, Jr. et al. with UV radiation in order to increase the quality of the film and reduce the impurities in the film (Abstract and Col.5, lines 31 – 47 of Thakur). Therefore, it would have been obvious to one of ordinary skill in the art to perform the UV light exposure of DiMeo, Jr. et al. continuously throughout the process (i.e., including between each pulse of precursor fluid) with the reasonable expectation of successfully and advantageously reducing the film deposition temperature and increasing the quality of the film by reducing the impurities in the film. The UV light exposure between pulses of precursor fluid is equivalent to the applicant's claimed annealing step.

28. Claims 52 – 55, 58 - 72, and 74 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gates et al. (USPN 6,203,613 B1) in view of DiMeo, Jr. et al. (USPN 5,972,430), and in further view of Moore et al. (USPN 5,710,407).
29. Regarding independent Claim 52, Gates et al. teach a process for forming layers in electronic devices (Col.1, lines 5 – 20), the process comprising the steps of providing a reaction chamber, placing a substrate in the reaction chamber, pulsing a precursor fluid into the reaction chamber (Cols.5 – 6 and Examples 1 – 8), causing the precursor fluid to convert into a solid layer on the substrate (Examples 1 – 8), wherein the precursor fluid is substantially exhausted and removed from the reaction chamber in between each pulse of the precursor fluid (Col.6, lines 13 – 33, and Examples 1 – 8). Gates et al. also teach that this method is useful for

depositing oxides and mixed oxide layers on a heated substrate (Col.7, lines 4 – 9, and Col.9, lines 20 – 44). Gates et al. do not explicitly teach exposing the precursor fluid to light energy in the reaction chamber to cause the precursor to deposit onto the substrate. DiMeo, Jr. et al. teach a similar process of depositing the same category of mixed oxide layers onto a heated substrate using ALD. DiMeo, Jr. et al. also teach that light energy can be used in addition to thermal energy to activate the deposition process (Col.10, lines 53 – 64). It would have been obvious to one of ordinary skill in the art to couple the light energy activation taught by DiMeo, Jr. et al. with the thermal energy activation deposition process of Gates et al. with the reasonable expectation of successfully depositing the films of Gates et al. with the benefit of an additional light activation means as taught by DiMeo, Jr. et al. (e.g., reducing the deposition temperature). In addition, the combination of Gates et al. and DiMeo, Jr. et al. does not explicitly teach that the reaction chamber is a “cold wall” chamber. Specifically, the combination is silent as to whether the chamber is a “hot wall” chamber or a “cold wall” chamber. Moore et al. teach a similar deposition method and apparatus to that of DiMeo, Jr. et al. (i.e., a deposition method and apparatus in which both heat and a radiant light source are utilized during the deposition process) (Abstract, Col.1, lines 28 – 32, Col.4, lines 1 – 25, Col.5, lines 25 – 28, and Col.14, lines 12 – 19). Moore et al. also teach that, in such a deposition system, a cold wall reaction chamber is preferred because undesirable deposits do not build up on the chamber walls (Col.2, lines 20 – 25). Specifically, Moore et al. teach that the walls of the chamber are maintained at a cool

temperature relative to the operating temperature of the reaction chamber in order to avoid deposition of a film on the walls of the chamber. Such a deposited film would detrimentally absorb heat energy, thereby affecting the heat distribution in the reaction chamber and resulting in unacceptable temperature gradients in the wafer substrate. In addition, a film on the walls may undesirably produce particulates during reactor operation, thereby contaminating the substrate (Col.19, lines 22 – 35). Therefore, it would have been obvious to one of ordinary skill in the art to use a cold wall chamber in the process of the combination of Gates et al. and DiMeo, Jr. et al. with the reasonable expectation of successfully and advantageously preventing unwanted film deposition on the reaction chamber walls, thereby preventing unacceptable temperature gradients in the substrate and preventing particulate contamination of the substrate.

30. The combination of Gates et al., DiMeo, Jr. et al., and Moore et al. also teaches all the limitations of Claims 53 – 55, 58 - 72, and 74 as set forth above in paragraph 29 and below, including a method wherein:

- Claims 53 – 54 – The precursor fluid comprises either a liquid vapor or a gas (Col.6 of Gates et al.).
- Claim 55 – The substrate comprises a semiconductor wafer (Col.7, line 30 of Gates et al.).
- Claim 58 – The reaction chamber is maintained at less than atmospheric pressure. While Gates et al. is silent as to the deposition pressure, DiMeo, Jr. et al. teach that a suitable pressure for the deposition of mixed metal oxides

as desired by Gates et al. is from about 0.02 to about 10 torr (i.e., less than atmospheric pressure). Therefore, it would have been obvious to one of ordinary skill in the art to choose a deposition pressure in this range and optimize the exact pressure through routine experimentation depending on the composition of the film being deposited.

- Claim 59 – The light energy is pulsed in substantial synchronization with the precursor fluid (see paragraph 23 above).
- Claim 60 – Flowing an inert gas through the reaction chamber in between pulses of the precursor fluid in order to purge the reaction chamber (Col.6 and Col.7, lines 10 – 20 of Gates et al.).
- Claims 61 – 62 – The solid layer comprises a dielectric material or a conductive material (Col.2, lines 20 – 25, Col.4, lines 40 – 51, and Examples 1 – 8 of Gates et al.).
- Claim 63 – The solid layer comprises zirconium oxide (Example 1).
- Claim 64 – The precursor fluid comprises a hydride (Col.3, line 59).
- Claim 65 – The solid layer comprises a material selected from the group consisting of tungsten, tungsten nitride, tantalum nitride, titanium nitride, copper, aluminum, ruthenium oxide, iridium oxide, and silver (Example 5).
- Claim 66 - The solid layer comprises a material selected from the group consisting of zirconium oxide, aluminum oxide, a nitride, barium strontium titanate, and a silicate (Col.9, lines 15 – 50).
- Claim 67 – The solid layer comprises zirconium hafnium oxide (Example 3).

- Claim 68 – The reaction chamber is maintained at a pressure of less than about 5 torr (see Claim 58 above).
- Claim 69 – The substrate is maintained at a temperature of at least 100° C during formation of the solid layer (Col.7, line 9).
- Claims 70 and 72 – The reaction chamber includes walls, the walls being made from an insulating material, specifically quartz (Col.11, lines 58 – 67 of Moore et al.).
- Claim 71 – The reaction chamber includes a cooling system for cooling the walls of the chamber (Col.5, lines 20 – 25 of Moore et al.).
- Claim 74 – Between each pulse of precursor fluid, the solid layer being formed is cooled. While this limitation is not explicitly taught by the combination of Gates et al. and DiMeo, Jr. et al., the combination does suggest that the UV light energy is only utilized during the precursor pulsing steps and that an inert gas is flowed through the reaction chamber in between pulses of the precursor fluid (see discussion of Claims 59 and 60 above). As such, it is the examiner's position that the lack of UV light energy and the flow of inert gas between precursor fluid pulses would have inherently provided at least some cooling of the deposited layer (i.e., due to the lack of UV-light as an additional energy source and convection cooling of the deposited layer by the inert gas purge).

31. Claims 56 and 57 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gates et al. (USPN 6,203,613 B1) in view of DiMeo, Jr. et al. (USPN 5,972,430), in further view of Moore et al. (USPN 5,710,407), and in further view of Murota et al. (USPN 5,705,224).
32. The combination of Gates et al., DiMeo, Jr. et al., and Moore et al. teaches all the limitation of Claims 56 and 57 as set forth above in paragraph 29, except for a process further comprising the step of heating the substrate with an electrical resistance heater during formation of the layer (Claim 56) and wherein the light energy is supplied by light energy sources positioned outside the reaction chamber (Claim 57). Gates et al. do teach a deposition temperature of from 200° to 400° C but are silent as to how the substrate is heated (Col.7, lines 4 – 9). Murota et al. teach a similar photo-induced ALD process in which the substrate is successfully heated through the use of an electrical resistance heater placed adjacent to the substrate (Col.4, lines 24 – 37, and Figure 1, reference numbers 11 – 12). It would have been obvious to one of ordinary skill in the art to heat the substrate of Gates et al. with the electrical resistance heater of Murota et al. with the reasonable expectation of successfully heating the substrate to a desired deposition temperature through the use of an electrical resistance heater (i.e., choosing a well-known species (an electrical resistance heater) out of the broader genus of heating the in general, taught by Gates et al.). In addition, DiMeo, Jr. et al. are silent as to the placement of the light sources. Murota et al. teach a similar photo-induced ALD process wherein the light sources are positioned outside the reaction chamber

(Figure 1 and Col.5, lines 1 – 5). It would have been obvious to one of ordinary skill in the art to position the light sources of the combination of Gates et al. and DiMeo, Jr. et al. outside the reaction chamber as taught by Murota et al. with the reasonable expectation of successfully treating the layer with light energy as desired by DiMeo, Jr. et al. without contaminating the light sources by placing the light sources outside the deposition chamber as taught by Murota et al.

33. Claims 52, 54 – 59, 61, 64, and 68 – 74 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nishizawa et al. (USPN 5,443,033) in view of Moore et al. (USPN 5,710,407).
34. Regarding independent Claim 52, Nishizawa et al. teach a process for forming layers in electronic devices (Col.2, lines 4 – 6), the process comprising the steps of providing a reaction chamber, placing a substrate in the reaction chamber, pulsing a precursor fluid into the reaction chamber (Figs. 1, 4, and 5, and Cols. 4 – 5), exposing the precursor fluid to light energy in the reaction chamber causing the precursor fluid to convert into a solid layer on the substrate (Col.5, lines 1 – 7, and Col.6, lines 22 – 28), wherein the precursor fluid is substantially exhausted and removed from the reaction chamber in between each pulse of the precursor fluid (Cols.4 – 5, especially Col.4, lines 52 – 68, and Col.5, lines 1 – 32). Nishizawa et al. do not explicitly teach that the reaction chamber is a “cold wall” chamber. Specifically, Nishizawa et al. are silent as to whether the chamber is a “hot wall” chamber or a “cold wall” chamber. However, the reaction chamber of Nishizawa et

al. does not appear to be directly heated, as the substrate temperature is maintained by the heater "10" placed adjacent to the substrate (see Figure 1 and Col.4, lines 60 – 61). Moore et al. teach a similar deposition method and apparatus to that of Nishizawa et al. (i.e., a deposition method and apparatus in which both a heating element placed adjacent to the substrate and radiant light source are utilized during the deposition process) (Abstract, Col.1, lines 28 – 32, Col.4, lines 1 – 25, Col.5, lines 25 – 28, and Col.14, lines 12 – 19). Moore et al. also teach that, in such a deposition system, a cold wall reaction chamber is preferred because undesirable deposits do not build up on the chamber walls (Col.2, lines 20 – 25). Specifically, Moore et al. teach that the walls of the chamber are maintained at a cool temperature relative to the operating temperature of the reaction chamber in order to avoid deposition of a film on the walls of the chamber. Such a deposited film would detrimentally absorb heat energy, thereby affecting the heat distribution in the reaction chamber and resulting in unacceptable temperature gradients in the wafer substrate. In addition, a film on the walls may undesirably produce particulates during reactor operation, thereby contaminating the substrate (Col.19, lines 22 – 35). Therefore, it would have been obvious to one of ordinary skill in the art to use a cold wall chamber in the process of Nishizawa et al. with the reasonable expectation of successfully and advantageously preventing unwanted film deposition on the reaction chamber walls, thereby preventing unacceptable temperature gradients in the substrate and preventing particulate contamination of the substrate.

35. The combination of Nishizawa et al. and Moore et al. also teaches all the limitations of Claims 54 – 59, 61, 64, and 68 – 74 as set forth above in paragraph 34 and below, including a method wherein:

- Claim 54 – The precursor fluid comprises a gas (Col.6, lines 22 – 28).
- Claim 55 – The substrate comprises a semiconductor wafer (Col.4, lines 52 – 56).
- Claim 56 – The substrate is heated with an electrical resistance heater during the formation of the layer (Col.4, lines 33 – 39 and 60 – 61).
- Claim 57 – The light energy is supplied by light energy sources positioned outside the reaction chamber (Figs. 1 and 10, reference number 14).
- Claim 58 – The reaction chamber is maintained at less than atmospheric pressure (Col.4, line 57).
- Claim 59 – The light energy is pulsed in substantial synchronization with the precursor fluid. While this limitation is not explicitly taught by Nishizawa et al., Nishizawa et al. do teach that the UV radiation can be applied intermittently during the process of growth (Col.6, lines 22 – 28). Therefore, absent any showing of criticality or unexpected results, it would have been obvious to one of ordinary skill in the art to pulse the light energy of Nishizawa et al. at any time during the process of growth, including in synchronization with the pulses of precursor fluid.
- Claim 61 – The solid layer comprises a dielectric material (Col.5, lines 1 – 7).

- Claim 64 – The precursor fluid comprises a hydride (Col.4, line 66, and Col.5, line 22).
- Claim 68 – The reaction chamber is maintained at a pressure of less than about 5 torr (Col.4, line 57, and Col.5, line 1).
- Claim 69 – The substrate is maintained at a temperature of at least 100° C during formation of the solid layer (Col.4, lines 60 – 61).
- Claims 70 and 72 – The reaction chamber includes walls, the walls being made from an insulating material, specifically quartz (Col.11, lines 58 – 67 of Moore et al.).
- Claim 71 – The reaction chamber includes a cooling system for cooling the walls of the chamber (Col.5, lines 20 – 25 of Moore et al.).
- Claim 73 – Between selected pulses of the precursor fluid, the solid layer being formed is annealed. Specifically, Nishizawa et al. teach that the substrate with the growing epitaxial layer is irradiated with UV irradiation continuously during the process of growth (Col.6, lines 22 – 28). This time period (i.e., the period of growth) includes the time period in which the chamber is exhausted between the pulses of reactant gases (Col.4, lines 52 – 68, and Col.5, lines 1 – 7). The UV light exposure between pulses of precursor fluid is equivalent to the applicant's claimed annealing step.
- Claim 74 – Between each pulse of precursor fluid, the solid layer being formed is cooled. While this limitation is not explicitly taught by Nishizawa et al., Nishizawa et al. do suggest that the UV light energy is only utilized during

the precursor pulsing steps (see discussion of Claim 59 above). As such, it is the examiner's position that the lack of UV light energy between precursor fluid pulses would have inherently provided at least some cooling of the deposited layer (i.e., due to the lack of UV-light as an additional energy source).

36. Claim 60 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nishizawa et al. (USPN 5,443,033) in view of Moore et al. (USPN 5,710,407), and in further view of Dautartas et al. (USPN 6,124,158).
37. The combination of Nishizawa et al. and Moore et al. teaches all the limitations of Claim 60 as set forth above in paragraph 34, except for a process further comprising the step of flowing an inert gas through the reaction chamber in between pulses of precursor fluid in order to purge from the reaction chamber any precursor fluid not converted into a solid. However, Nishizawa et al. do teach that between the pulses of precursor fluid, the chamber is evacuated (Col.4, lines 60 – 68). Dautartas et al. teach a similar atomic layer epitaxial process for depositing a layer in a semiconductor device (Abstract). Further, Dautartas et al. teach that it was known in the art at the time of the applicant's invention to purge a reaction chamber with an inert gas between pulses of precursor gases to remove residual reactive material from the chamber in order to prevent reactions from taking place except on the surface of the substrate (Col.3, lines 23 – 67, and Col.4, line 1). Therefore, it would have been obvious to one of ordinary skill in the art to purge the reaction chamber

of Nishizawa et al. with an inert gas between the precursor gas pulses (i.e., instead of simply evacuating the chamber between pulses as taught by Nishizawa et al.) in order to substantially remove any remaining vaporous precursor material from the chamber with the reasonable expectation of (1) success, as Dautartas et al. teach that such a process is possible and known in the art, and (2) obtaining the benefits of the inert gas purging step, such as removing residual reactive material from the chamber in order to prevent reactions from taking place except on the surface of the substrate. Dautartas et al. teach that this purging technique eliminates gas phase reactions and gas phase powder formation, both of which detract from the quality of the film (Col.3, lines 66 – 67, and Col.4, line 1).

Response to Arguments

38. Applicant's arguments filed on 10/7/2002 have been fully considered but they are not persuasive. Specifically, the applicant's arguments are moot in view of the new grounds of rejection presented above.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wesley D Markham whose telephone number is (703) 308-7557. The examiner can normally be reached on Monday - Friday, 8:00 AM to 4:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shrive Beck can be reached on (703) 308-2333. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications.

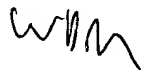

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

Wesley D Markham
Examiner
Art Unit 1762

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WDM
December 11, 2002

A handwritten signature in black ink, appearing to be 'WDM', located below the typed name 'WDM'.A handwritten signature in black ink, appearing to be 'Shrive P. Beck', located above the typed name.

SHRIVE P. BECK
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700